

Chapter 44

Prevention of Chronic Disease by Means of Diet and Lifestyle Changes



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Coronary artery disease (CAD), ischemic stroke, diabetes, and some specific cancers, which until recently were common only in high-income countries, are now becoming the dominant sources of morbidity and mortality worldwide (WHO 2002). In addition, rates of cancers and cardiovascular disease (CVD) among migrants from low-risk to high-risk countries almost always increase dramatically. In traditional African societies, for example, CAD is virtually nonexistent, but rates among African Americans are similar to those among Caucasian Americans. These striking changes in rates within countries over time and among migrating populations indicate that the primary determinants of these diseases are not genetic but environmental factors, including diet and lifestyle. Thus, considerable research has been aimed at identifying modifiable determinants of chronic diseases.

Prospective epidemiological studies, some randomized prevention trials, and many short-term studies of intermediate endpoints such as blood pressure and lipids have revealed a good deal about the specific dietary and lifestyle determinants of major chronic diseases. Most of these studies have been conducted in Western countries, in part because of the historical importance of these diseases in the West, but also because they have the most developed research infrastructure. A general conclusion is that reducing identified, modifiable dietary and lifestyle risk factors could prevent most cases of CAD, stroke, diabetes, and many cancers among high-income populations (Willett 2002). These findings are profoundly important, because they indicate that these diseases are not inevitable consequences of a modern society. Furthermore, low rates of these diseases can be attained without drugs or expensive medical

facilities, an outcome that is not surprising, because their rates have historically been extremely low in developing countries with few medical facilities. However, preventing these diseases will require changes in behaviors related to smoking, physical activity, and diet; investments in education, food policies, and urban physical infrastructure are needed to support and encourage these changes (see box 44.1).

CHRONIC DISEASE PREVENTION

In this section, we briefly review dietary and lifestyle changes that reduce the incidence of chronic disease. The potential magnitude of benefit is also discussed.

Recommended Lifestyle Changes

Specific changes in diet and lifestyle and likely benefits are summarized in table 44.1. These relationships and supporting evidence are summarized here.

Avoid Tobacco Use. Avoidance of smoking by preventing initiation or by cessation for those who already smoke is the single most important way to prevent CVD and cancer (chapter 46). Avoiding the use of smokeless tobacco will also prevent a good deal of oral cancer.

Maintain a Healthy Weight. Obesity is increasing rapidly worldwide (chapter 45). Even though obesity—a body mass index (BMI) of 30 or greater—has received more attention

Box 44.1

The Insulin Resistance Syndrome

In recent years, researchers have recognized the insulin resistance syndrome (also known as the *metabolic syndrome*) as a common contributing factor to the development of diabetes, CAD, and some cancers. The syndrome is characterized by increased waist circumference, low HDL (high-density lipoprotein) cholesterol, high levels of triglycerides, hypertension, and glucose intolerance. The

most direct causes are overweight and inactivity, but dietary factors contribute. Genetic factors, which are probably beneficial during periods of food shortages, also play a role. Recent evidence indicates that the populations of Asia, Latin America, and probably Africa are particularly susceptible (Dickinson and others 2002; Harris and others 1998).

Table 44.1 Convincing and Probable Relationships between Dietary and Lifestyle Factors and Chronic Diseases

Dietary and lifestyle factors	CVD	Type 2 diabetes	Cancer	Dental disease	Fracture	Cataract	Birth defects	Obesity	Metabolic syndrome	Depression	Sexual dysfunction
Avoid smoking	↓	↓	↓	↓	↓	↓		↑			↓
Pursue physical activity	↓	↓	↓		↓			↓	↓	↓	↓
Avoid overweight	↓	↓	↓		↑	↓			↓		↓
<i>Diet</i>											
Consume healthy types of fats ^a	↓	↓							↓		
Eat plenty of fruits and vegetables	↓		↓		↓	↓	↓	↓			
Replace refined grains with whole grains	↓	↓						↓	↓		
Limit sugar intake ^b	↓	↓		↓				↓	↓		
Limit excessive calories								↓	↓		
Limit sodium intake	↓										

Source: Authors' summary of a review by the WHO and FAO 2003; Bacon and others 2003; Fox 1999; IARC 2002.

Note: **Bold** = convincing; Standard = probable relation; ↑ = increase in risk; ↓ = decrease in risk.

a. Replace trans and saturated fats with mono- and polyunsaturated fats, including a regular source of N-3 fatty acids.

b. Includes limiting sugar-based beverages.

than overweight, overweight (BMI of 25 to 30) is typically even more prevalent and also confers elevated risks of many diseases. For example, overweight people experience a two- to threefold elevation in the risks of CAD and hypertension and a more than tenfold increase in the risk of type 2 diabetes compared with lean individuals (BMI less than 23) (Willett, Dietz, and Colditz 1999). Both overweight and obese people also

experience elevated mortality from cancers of the colon, breast (postmenopausal), kidney, endometrium, and other sites (Calle and others 2003).

Many people with a BMI of less than 25 have gained substantial weight since they were young adults and are also at increased risk of these diseases, even though they are not technically overweight (Willett, Dietz, and Colditz 1999). For

example, in rural China, where the average BMI was less than 21 for both men and women, F. B. Hu and others (2000) found that the prevalence of hypertension was nearly five times greater for those with a BMI of approximately 25 than for the leanest people. Because many Asians are experiencing adverse consequences of excess body fat with a BMI of less than 25, the definition of overweight for Asia has recently been expanded to include a BMI of 23 to 25 (WHO 2000). For most people, unless obviously malnourished as an adolescent or young adult, bodyweight should ideally not increase by more than 2 or 3 kilograms after age 20 to maintain optimal health (Willett, Dietz, and Colditz 1999). Thus, a desirable weight for most people should be within the BMI range of 18.5 to 25.0, and preferably less than 23.

Additional valuable information can be obtained by measuring waist circumference, which reflects abdominal fat accumulation. In many studies, waist circumference is a strong predictor of CAD, stroke, and type 2 diabetes, even after controlling for BMI (Willett, Dietz, and Colditz 1999). A waist circumference of approximately 100 centimeters for men and 88 centimeters for women has been used as the criterion for the upper limit of the healthy range in the United States, but for many people this extent of abdominal fat would be far above optimal. Because abdominal circumference is easily assessed, even where scales may not be available, further work to develop locally appropriate criteria could be worthwhile. In the meantime, increases of more than 5 centimeters can be used as a basis for recommending changes in activity patterns and diet.

Views about the causes of obesity and ways to prevent or reduce it have been controversial. Diets low in fat and high in carbohydrates were believed to limit caloric intake spontaneously and thus to control adiposity, but such diets have not reduced bodyweight in trials that have lasted for a year or more (Willett and Leibel 2002). Some researchers have suggested that diets with a high energy density, referring to the amount of energy per volume, offer an alternative explanation for the observed increases in obesity (Swinburn and others 2004), but long-term studies have not examined this theory. Sugar-sweetened beverages contribute significantly to the overconsumption of calories, in part because calories in fluid form appear to be poorly regulated by the body (E. A. Bell, Roe, and Rolls 2003). In children, an increase in soda consumption of one serving per day was associated with an odds ratio of 1.6 for incidence of obesity (Ludwig, Peterson, and Gortmaker 2001), and in a randomized trial, replacement of a standard soda with a zero-calorie diet soda was associated with significant weight loss (Raben and others 2002). Reductions in dietary fiber and increases in the dietary glycemic load (large amounts of rapidly absorbed carbohydrates from refined starches and sugar) may also contribute to obesity (Ebbeling and others 2003; Swinburn and others 2004).

Aspects of the food supply unrelated to its macronutrient composition are also likely to be contributing to the global rise in obesity. Inexpensive food energy from refined grains, sugar, and vegetable oils has become extremely plentiful in most countries. Food manufacturers and suppliers use carefully researched methods to make products based on these cheap ingredients maximally convenient and attractive.

Maintain Daily Physical Activity and Limit Television Watching. Contemporary life in developed nations has markedly reduced people's opportunities to expend energy, whether in moving from place to place, in the work environment, or at home (Koplan and Dietz 1999). Dramatic reductions in physical activity are also occurring in developing countries because of urbanization, increased availability of motorized transportation to replace walking and bicycle riding, and mechanization of labor. However, regular physical activity is a key element in weight control and prevention of obesity (IARC 2002; Swinburn and others 2004). For example, among middle-aged West African women, more walking was associated with a three-unit lower BMI (Sobngwi, Gautier, and Mbanya 2003), and in China, car owners are 80 percent more likely to be obese (Hu 2002).

In addition to its key role in maintaining a healthy weight, regular physical activity reduces the risk of CAD, stroke, type 2 diabetes, colon and breast cancer, osteoporotic fractures, osteoarthritis, depression, and erectile dysfunction (table 44.1). Important health benefits have even been associated with walking for half an hour per day, but greater reductions in risk are seen with longer durations of physical activity and more intense activity.

The number of hours of television watched per day is associated with increased obesity rates among both children and adults (Hernandez and others 1999; Ruangdaraganon and others 2002) and with a higher risk of type 2 diabetes and gallstones (F. B. Hu and others 2001; Leitzmann and others 1999). This association is likely attributable both to reduced physical activity and to increased consumption of foods and beverages high in calories, which are typically those promoted on television. Decreases in television watching reduce weight (Robinson 1999), and the American Academy of Pediatrics recommends a maximum of two hours of television watching per day.

Eat a Healthy Diet. Medical experts have long recognized the effects of diet on the risk of CVD, but the relationship between diet and many other conditions, including specific cancers, diabetes, cataracts, macular degeneration, cholelithiasis, renal stones, dental disease, and birth defects, have been documented more recently. The following list discusses six aspects of diet for which strong evidence indicates important health implications (table 44.1). These goals are consistent with a detailed

2003 World Health Organization (WHO) report (WHO and FAO 2003).

- *Replace saturated and trans fats with unsaturated fats, including sources of omega-3 fatty acids.* Replacing saturated fats with unsaturated fats will reduce the risk of CAD (F. B. Hu and Willett 2002; Institute of Medicine 2002; WHO and FAO 2003) by reducing serum low-density lipoprotein (LDL) cholesterol. Also, polyunsaturated fats (including the long-chain omega-3 fish oils and probably alpha-linoleic acid, the primary plant omega-3 fatty acid) can prevent ventricular arrhythmias and thereby reduce fatal CAD. In a case-control study in Costa Rica, where fish intake was extremely low, the risk of myocardial infarction was 80 percent lower in those with the highest alpha-linoleic acid intake (Baylin and others 2003). Intakes of omega-3 fatty acids are suboptimal in many populations, particularly if fish intake is low and the primary oils consumed are low in omega-3 fatty acids (for example, partially hydrogenated soybean, corn, sunflower, or palm oil). These findings have major implications, because changes in the type of oil used for food preparation are often quite feasible and not expensive.

Trans fatty acids produced by the partial hydrogenation of vegetable oils have uniquely adverse effects on blood lipids (F. B. Hu and Willett 2002; Institute of Medicine 2002) and increase risks of CAD (F. B. Hu and Willett 2002); on a gram-for-gram basis, both the effects on blood lipids and the relationship with CAD risk are considerably more adverse than for saturated fat. In many developing countries, trans fat consumption is high because partially hydrogenated soybean oil is among the cheapest fats available. In South Asia, vegetable ghee, which has largely replaced traditional ghee, contains approximately 50 percent trans fatty acids (Ascherio and others 1996). Independent of other risk factors, higher intakes of trans fat and lower intakes of polyunsaturated fat increase risk of type 2 diabetes (F. B. Hu, van Dam, and Liu 2001).

- *Ensure generous consumption of fruits and vegetables and adequate folic acid intake.* Strong evidence indicates that high intakes of fruits and vegetables will reduce the risk of CAD and stroke (Conlin 1999). Some of this benefit is mediated by higher intakes of potassium, but folic acid probably also plays a role (F. B. Hu and Willett 2002). Supplementation with folic acid reduces the risk of neural tube defect pregnancies. Substantial evidence also suggests that low folic acid intake is associated with greater risk of colon—and possibly breast—cancer and that use of multiple vitamins containing folic acid reduces the risk of these cancers (Giovannucci 2002). Findings relating folic acid intake to CVD and some cancers have major implications for many parts of the developing world. In many areas, consumption

of fruits and vegetables is low. For example, in northern China, approximately half the adult population is deficient in folic acid (Hao and others 2003).

- *Consume cereal products in their whole-grain, high-fiber form.* Consuming grains in a whole-grain, high-fiber form has double benefits. First, consumption of fiber from cereal products has consistently been associated with lower risks of CAD and type 2 diabetes (F. B. Hu, van Dam, and Liu 2001; F. B. Hu and Willett 2002), which may be because of both the fiber itself and the vitamins and minerals naturally present in whole grains. High consumption of refined starches exacerbates the metabolic syndrome and is associated with higher risks of CAD (F. B. Hu and Willett 2002) and type 2 diabetes (F. B. Hu, van Dam, and Liu 2001). Second, higher consumption of dietary fiber also appears to facilitate weight control (Swinburn and others 2004) and helps prevent constipation.
- *Limit consumption of sugar and sugar-based beverages.* Sugar (free sugars refined from sugarcane or sugar beets and high-fructose corn sweeteners) has no nutritional value except for calories and, thus, has negative health implications for those at risk of overweight. Furthermore, sugar contributes to the dietary glycemic load, which exacerbates the metabolic syndrome and is related to the risk of diabetes and CAD (F. B. Hu, van Dam, and Liu 2001; F. B. Hu and Willett 2002; Schulze and others 2004). WHO has suggested an upper limit of 10 percent of energy from sugar, but lower intakes are usually desirable because of the adverse metabolic effects and empty calories.
- *Limit excessive caloric intake from any source.* Given the importance of obesity and overweight in the causation of many chronic diseases, avoiding excessive consumption of energy from any source is fundamentally important. Because calories consumed as beverages are less well-regulated than calories from solid food, limiting the consumption of sugar-sweetened beverages is particularly important.
- *Limit sodium intake.* The principle justification for limiting sodium is its effect on blood pressure, a major risk factor for stroke and coronary disease (chapter 33). WHO has suggested an upper limit of 1.7 grams of sodium per day (5 grams of salt per day) (WHO and FAO 2003).

Potential of Dietary and Lifestyle Factors to Prevent Chronic Diseases

Several lines of evidence indicate that realistic modifications of diet and lifestyle can prevent most CAD, stroke, diabetes, colon cancer, and smoking-related cancers. Less progress has been made in identifying practically modifiable causes of breast and prostate cancers.

Box 44.2

Success in Finland

Finland provides one of the best-documented examples of a community intervention. In 1972, Finland had the world's highest CVD mortality rate. Planners examined the policy and environmental factors contributing to CVD and sought appropriate changes, such as increased availability of low-fat dairy products, antismoking legislation, and improved school meals. They used the media; schools; worksites; and spokespersons from sports, education, and agriculture to educate residents. After five years, signifi-

cant improvements were documented in smoking, cholesterol, and blood pressure. By 1992, CVD mortality rates for men age 35 to 64 had dropped by 57 percent. The program was so successful that it was expanded to include other lifestyle-related diseases. Twenty years later, major reductions in CVD risk-factor levels, morbidity, and mortality were attributed to the project. Recent data show a 75 percent decrease in CVD mortality (Puska and others 1998).

One line of evidence is based on declines in CAD in countries that have implemented preventive programs. Rates of CAD mortality have been cut in half in several high-income countries, including Australia, the United Kingdom, and the United States. The most dramatic example is that of Finland (box 44.2).

Other evidence derives from randomized intervention studies. These often have serious limitations for estimating the potential magnitude of benefits, because typically only one or a few factors are modified, durations are usually only a few years, and noncompliance with lifestyle change is often substantial. Nevertheless, some examples are illustrative of the potential benefit. In two randomized studies among adults at high risk of type 2 diabetes, those assigned to a program emphasizing dietary changes, weight loss, and physical activity experienced only half the risk of incident diabetes (Knowler and others 2002; Tuomilehto and others 2001). The Lyon Heart Study, conducted among those with existing heart disease, found a Mediterranean-type diet high in omega-3 fatty acids reduced recurrent infarction by 70 percent compared with an American Heart Association diet (de Lorgeril and others 1994).

A third approach is to estimate the percentage of disease that is potentially preventable by reducing multiple behavioral risk factors using prospective cohort studies. Among U.S. adults, more than 90 percent of type 2 diabetes, 80 percent of CAD, 70 percent of stroke, and 70 percent of colon cancer are potentially preventable by a combination of nonsmoking, avoidance of overweight, moderate physical activity, healthy diet, and moderate alcohol consumption (Willett 2002).

Collectively, these findings indicate that the low rates of these diseases suggested by international comparisons and time trends are attainable by realistic, moderate changes that are compatible with 21st-century lifestyles.

INTERVENTIONS

Interventions aimed at changing diet and lifestyle factors include educating individuals, changing the environment, modifying the food supply, undertaking community interventions, and implementing economic policies. In most cases, quantifying the effects of the intervention is difficult, because behavioral changes may take many years and synergies are potentially important but hard to estimate in formal studies. Substantial nihilism often exists regarding the ability to change populations' diets or behaviors, but major changes are possible over extended periods of time. For example, per capita egg consumption in the United States decreased from approximately 420 to 270 per year between 1940 and 1990 following recommendations for preventing CAD (though in reality, the evidence for benefits was meager). Similarly, the prevalence of smoking, despite its being a physically addictive behavior, halved among men in the United States between 1965 and 2000. Because changing behaviors related to diet and lifestyle require sustained efforts, long-term persistence is needed. However, opportunities exist that do not require individual behavior changes, and these can lead to more rapid benefits.

Educational Interventions

Efforts to change diets, physical activity patterns, and other aspects of lifestyle have traditionally attempted to educate individuals through schools, health care providers, worksites, and general media. These efforts will continue to play an important role, but they can be strongly reinforced by policy and environmental changes.

School-Based Programs. School-based programs include the roles of nutrition and physical activity in maintaining physical

Box 44.3

The Planet Health Program

Planet Health, developed for middle school students, in the United States, has an immediate goal of reducing television viewing time with the long-range goal of preventing unhealthy weight gain (Gortmaker and others 1999). Teachers incorporate messages about reducing television watching, nutrition, and increasing fitness into mathematics, social studies, science, and language arts lessons. Fitness units and periodic “FitChecks” during physical

education complement the classroom lessons. Teacher training, student self-assessment using graphs, and student reflection about enjoyable activities that could replace at least a portion of the time they spend watching television are key elements. This program has reduced television watching and weight in girls (Gortmaker and others 1999). Because the program is integrated into existing classes, its cost is minimal.

Box 44.4

Live for Life®

Johnson & Johnson introduced Live for Life in 1979 with the goal of making its employees the healthiest in the world (Bly, Jones, and Richardson 1986). In 1993, the company integrated its health and wellness program with its disability management, employee assistance, and occupational medicine programs. Instead of using physicians and nurses to treat symptoms, the combined program sought to use a variety of health professionals to change individual behavior and improve health status. Employees

were offered US\$500 in benefit credits for participation. The program included routine health risk assessment, health promotion after recovery from a medical event, and support when returning to work after a major illness. Even though the intervention program had little effect on body-weight, physical fitness did increase. By the end of the third year, savings to the company were more than US\$400 per year per employee.

and mental health (box 44.3). School food services should provide healthy meals, both because they directly affect health and because they provide a special opportunity to teach by example. In many countries, school-based physical education remains a significant source of physical activity for young people. In China, 72 percent of children age 6 to 18 engage in moderate to vigorous physical activity for a median of 90 to 100 minutes per week (Tudor-Locke and others 2003). Maintaining these programs should be a high priority because they have likely contributed to the historically low rates of obesity in such countries.

Worksite Interventions. Worksite interventions can efficiently include a wide variety of health promotion activities because workers spend a large portion of their waking hours and eat a large percentage of their food there. Interventions can include educating employees; screening them for behavioral risk factors; offering incentive programs to walk, ride a bicycle, or take public transportation to work; offering exercise

programs during breaks or after work; improving the physical environment to promote activity; and providing healthier foods in cafeterias (box 44.4). Worksite health promotion can result in a positive return on investment through lower health costs and fewer sick days.

Interventions by Health Care Providers. Controlled intervention trials for smoking cessation and physical activity have shown that physician counseling, especially when accompanied by supporting written material, can be efficacious in modifying behavior. Studies of dietary counseling by physicians indicate that even brief messages about nutrition can influence behavior and that the magnitude of the effect is related to the intensity of the intervention (Pignone and others 2003). Identifying patients who are overweight or obese, or who are gaining weight but are not yet overweight, is an initial step in preventing and treating overweight. However, many physicians are not well trained to measure and calculate BMI and identify weight problems.

Box 44.5

Reducing Automobile Use in Brazil

Curitiba, Brazil, provides an example of the benefits of a strategy that reduces automobile use and increases use of public transportation. In 1965, city planners adopted a master plan that promoted development along designated corridors along with a bus system so efficient that it has virtually eliminated the need for automobiles. Minibuses

are used to quickly and efficiently transport individuals from residential neighborhoods to express bus lines. These bus lines run almost every 90 seconds and can carry up to 270 passengers each. Compared with other Brazilian cities of its size, Curitiba uses 30 percent less gasoline per capita, and its air pollution is among the lowest in the nation.

Transportation Policy and Environmental Design

Transportation policies and the design of urban environments are fundamental determinants of physical activity and therefore influence the risks of obesity and other chronic diseases. Countries can take a number of steps to make positive changes.

Limit the Role of Automobiles. In wealthy countries, the automobile has strongly influenced the trend toward low-density, automobile-based suburban developments, many built without sidewalks. These sprawling settlements tend to have few services within walking distance and are usually not linked to public transportation. Dependence on automobiles affects physical activity, because those who use public transportation tend to walk more. In a prospective study in eight provinces in China, 14 percent of households acquired a car between 1889 and 1997, and the likelihood of men becoming obese during the same period was twice as great in households that acquired a car than in those that did not (A. C. Bell, Ge, and Popkin 2002).

National policies strongly influence automobile use and dependency. In the United States, low taxes on gasoline, free parking, and wide streets encourage car ownership: almost 92 percent of U.S. households own at least one car, and 59 percent own two or more cars (Pucher and Dijkstra 2003). In contrast, in most of Western Europe, narrow streets, limited parking, and high gasoline prices make the costs of automobile use almost double those in the United States (Pucher and Dijkstra 2003). As a result, Europeans walk or bike more and use their cars approximately 50 percent less than their American counterparts. Investment in roads rather than in public transportation creates a vicious cycle: poor public transportation systems lead to more dependency on the automobile.

As car use grows, injuries and deaths associated with automobile accidents also grow. In China, the number of four-wheeled vehicles increased from about 60,000 to more than 50 million between 1951 and 1999, and traffic fatalities increased from about 6,000 to more than 413,000 (S. Y. Wang and others 2003). Many innovative strategies have been

developed to discourage private automobile use and to promote public transportation, walking, and bicycling (see box 44.5). Singapore has long been in the lead in relation to such efforts: a combination of limiting the number of licenses issued, implementing a vehicle quota system, and introducing a road pricing system has limited personal car ownership and congestion throughout the country. Other nations and regions are now enacting similar road pricing systems or congestion taxes. For example, London's congestion charging system levies a fee of approximately US\$8 per day for cars entering central London. Since its inception in 2003, the charge has reduced congestion in the city and is expected to channel funds back into the city's transportation facilities.

Unfortunately some countries, particularly China, have taken a different approach to their future transportation needs. Government initiatives that encourage families to buy automobiles include lowering taxes, simplifying registration procedures, and allowing foreign financing. In Beijing alone, residents purchased 400,000 cars in 2003.

Promote Walking and Bicycle Riding. Walking or cycling for transportation and leisure are effective and practical means of engaging in physical activity and are still the most common ways to travel in many developing countries. In Bangkok and Manila, only 25 percent of travel is by car, motorcycle, or taxi, compared with 75 percent by public transportation or walking (Pendakur 2000). In Madras, India, only 8 percent of the population travels by private, motorized transportation; 22 percent of people walk; 20 percent bike; and the rest use public transportation (Pendakur 2000). In China, approximately 90 percent of the urban population walks or rides a bicycle to work, shopping, or school each day (G. Hu and others 2002). Walking or biking is more likely to be prevalent in smaller cities—that is, those with 1 million to 5 million people—than in larger ones.

Bicycle riding and walking are also important for children's health. Most American children do not walk or bike to school, even when distances are short (box 44.6). In contrast, almost

Box 44.6

Walking and Cycling to School

One of the most effective ways to promote walking and cycling is through local schools. The Safe Routes to School program (<http://www.saferoutestoschools.org/>), established in Marin County, California, is a private-public partnership that created a citywide map of safe biking and

walking routes and proposed solutions for problem areas. The program also sponsors walk- and bike-to-school days, frequent-rider contests, and other promotional events (Stanton, Hubsmith, and Kallins 2003).

90 percent of Chinese children under 12 walk or ride a bicycle to school (Hu 2002).

In many areas, the shift toward private car use has not yet begun and can perhaps be forestalled by policies that benefit walkers and cyclists rather than drivers. Such policies include implementing road designs that promote a safe and well-lit environment for walking and cycling, including traffic-calming measures to reduce automobile speeds.

Many Western European countries have taken steps to increase safety for cyclists and walkers. In Germany and the Netherlands, bike paths serve as travel routes, not just weekend recreational destinations as they do in the United States. The former countries have invested heavily in bike paths and have also created extensive car-free areas in cities, with well-lit sidewalks, clearly marked crosswalks, and pedestrian islands that have improved safety. Both countries have increased the number of bicycle-friendly streets (on which cars are permitted but bicycles have the right of way) and have created systems to separate streams of traffic, including cars, pedestrians, and bicycles. A meta-analysis of selected traffic-calming studies in many countries reported reductions in traffic speed, accidents, injuries, and fatalities and an increase in bicycle use and walking (Bunn and others 2003).

Design Cities and Towns to Promote Health. Handy and others' (2002) comprehensive assessment of recent research on urban planning concludes that a combination of urban design, land-use patterns, and transportation systems that promotes walking and bicycling will help create active, healthier, and more livable communities. In densely developed cities that have been built around public transportation rather than away from it, individuals are much more likely to take public transit, walk, or bicycle than in other areas and to weigh less and be less likely to suffer from hypertension (Ewing, Schieber, and Zegeer 2003; Lopez 2004; Saelens, Sallis, and Frank 2003).

Those living in walker-friendly neighborhoods also appear to be more mentally healthy and are more likely to know their neighbors, to be socially active, and to participate in the political process (Leyden 2003). In contrast, urban sprawl has been

linked to decreases in mental health and social capital (Frumkin 2002) as well as anger and frustration over long commutes (Surface Transportation Policy Project 1999). Sprawl adversely affects the elderly in particular because they are unable to walk to places of interest and many cannot drive. Such isolation does not promote good physical or mental health.

The so-called smart growth movement has resulted from concerns about urban sprawl and unsustainable development and is encouraging governments worldwide to rethink how they develop new areas and redevelop older suburbs and cities. Smart growth principles include mixing land uses, using compact building designs, including a range of transportation and housing choices, building walker-friendly neighborhoods in attractive communities with a distinctive sense of place, and implementing a philosophy of directing development toward existing communities and the preservation of open space (Office of the Administrator 2001) (box 44.7).

The involvement of public health practitioners in transportation planning and building design is becoming more common. In Edinburgh, a health impact assessment conducted on proposed options for transportation policy showed the effects of specific choices on both affluent members of the community and the poor. Its recommendations, now adopted, included new spending on pedestrian safety, a citywide bicycle network, more greenways and park-and-ride programs, and more rail transportation or bus services. Priorities are to benefit pedestrians first, cyclists second, public transportation users third, freight and delivery people fourth, and car users last. Establishing criteria for building design can also lead to increases in physical activity. For example, increasing signage promoting stair use, as well as the attractiveness of the facilities themselves, encourages people to use the stairs (Boutelle and others 2001) (box 44.8).

Improved Food Supply

People's diets can be enhanced by improving the food supply. The usual position of the food industry is that it simply

Box 44.7

Enhancing Urban Life in the Republic of Korea

In Seoul, the government is managing growth by creating six satellite communities with high-rise residential buildings outside the city center. These communities are intended to become new job-creation centers and to shift

the balance of employment away from one centralized location to provide a more regional balance. Major expressways are being removed to create parks, sidewalks, and bikeways (<http://www.itdp.org/STe/ste6/#seoul>).

Box 44.8

Promoting Physical Activity in Brazil

One successful example of increasing activity is Agita São Paulo, a multilevel physical activity initiative designed for the 34 million citizens of Brazil's São Paulo state (Matsudo and others 2002). The program was launched in 1996 to increase the public's knowledge of the benefits of exercise and expand participation in physical fitness activities by encouraging people to do 30 minutes of moderate activity at least five times a week. As elsewhere, program designers perceived a lack of time as the major factor preventing daily exercise. They chose three settings as places to promote activity: home (gardening, chores, avoidance of television watching); transportation (walking, taking the stairs); and leisure time (dancing). Agitol, a prescription for exercise, was developed for physicians to dispense. Its

message is displayed on electricity bills and stickers, and it is touted by radio stations and other media outlets.

After four years, 55.7 percent of those surveyed had heard about Agita, 37 percent knew its purpose, and those who knew of the program's purpose were more likely to be active. Agita appears to have played a role in increasing activity in the region (Matsudo and others 2002). It is closely linked to a national program to promote healthy diets and active lifestyles by nutritional content labeling, promotion of healthy diets in schools, communication of guidelines for healthy eating, and encouragement of innovative community-based initiatives (Coitinho, Monteiro, and Popkin 2002).

provides whatever consumers demand, but this argument is misleading, because the industry spends more than US\$12 billion annually to influence consumer choices just within the United States and many times this amount globally. Much of this sum goes to promote foods with adverse health effects, and children are primary targets.

Improving Processing and Manufacturing. Altering the manufacturing process can rapidly and effectively improve diets because such action does not require the slow process of behavioral change. One example is eliminating the partial hydrogenation of vegetable oils, which destroys essential omega-3 fatty acids and creates trans fatty acids. European manufacturers have largely eliminated trans fatty acids from their food supply by altering production methods.

Regulations can facilitate changes in manufacturing directly or indirectly by providing an incentive for manufacturers to change their processes. For example, in 2003, the U.S. Food and

Drug Administration announced that food manufacturers had to include trans fatty acid content on the standard food label. Following imposition of this requirement, several large food companies said that they would reduce or eliminate trans fats, and many more are planning to do so (U.S. Food and Drug Administration 2003). In Mauritius, the government required a change in the commonly used cooking oil from mostly palm oil to soybean oil, which changed people's fatty acid intake and reduced their serum cholesterol levels (Uusitalo and others 1996). Changes in types of fat can often be almost invisible and inexpensive. Omega-3 fatty acid intakes can be increased by incorporating oils from rapeseed, mustard, or soybean into manufactured foods, cooking oils sold for use at home, or both. Selective breeding and genetic engineering provide alternative ways to improve the healthfulness of oils by modifying their fatty acid composition.

When the consumption of processed food is high, a reduction in salt consumption will usually require changes at the

manufacturing level, because processed food is a major salt source. If the salt content of foods is reduced gradually, the change is imperceptible to consumers. Coordination among manufacturers or government regulation is needed; otherwise producers whose foods are lower in salt may be placed at a disadvantage. Unfortunately, good examples are not available. Another example of improved processing would be to reduce the refining of grain products, which can be done in small, almost invisible decrements.

Fortifying Food. Food fortification has eliminated iodine deficiency, pellagra, and beriberi in much of the world. In regions where iodine deficiency remains a serious problem, fortification should be a high priority. Folic acid intake is sub-optimal in many regions of both developing and developed countries. Fortifying foods with folic acid is extremely inexpensive and could substantially reduce the rates of several chronic diseases. Grain products—such as flour, rice, and pasta—are usually the best foods to fortify, and in many countries, they are already being fortified with other B vitamins. Since 1998, grain products in the United States have been fortified with folic acid, which has almost eliminated folate deficiency, and rates of neural tube defect pregnancies have declined by about 19 percent (Honein and others 2001). Where intakes of vitamins B12 and B6 are also low and contribute to elevations of homocysteine, as among vegetarian populations in India, simultaneous fortification of food with these vitamins should be considered. The effects of fortification on reducing CVD are not considered proven, but the potential benefits are huge; therefore, intervention trials to evaluate the effects of fortification should be a high priority.

Increasing the Availability and Reducing the Cost of Healthy Foods. Policies regarding the production, importation, distribution, and sale of specific foods can influence their cost and availability. Policies may be directed at the focus of agricultural research and the types of production promoted by extension services. Policies often promote grains, dairy products, sugar, and beef, whereas those that encourage the production and consumption of fruits, vegetables, nuts, legumes, whole grains, and healthy oils would tend to enhance rather than reduce health.

Promoting Healthy Food Choices and Limiting Aggressive Marketing to Children. Almost every national effort to improve nutrition incorporates the promotion of healthy food choices, such as fruits, vegetables, and legumes. Ideally, such efforts are coordinated among government groups, retailers, professional groups, and nonprofit organizations, and investment in such efforts should include the careful testing and refining of social-marketing strategies.

Another strategy is to protect consumers from aggressive marketing of unhealthy foods. Producers spend billions of dollars a year encouraging children to consume foods that are detrimental to their health. Manufacturers and fast-food chains personify food products with cartoon characters; display food brands on toys; and issue “educational” card games that subvert children’s natural gift for play, story telling, and make believe. The willingness to limit advertising depends on a country’s political culture, but the public clearly distinguishes between advertising aimed at adults and that targeted at children. For example, in the United States, 46 percent of adults surveyed supported restrictions on advertising to children (Blendon 2002). Restrictions can range from banning advertising to children to limiting the types of products that advertisers may promote to this audience.

Initiatives at the Community Level

Nations and regions can promote a variety of initiatives to encourage greater physical activity and better nutrition. These initiatives are likely to be most effective when they are multifaceted and coordinated and when they are developed with the active involvement of individuals and organizations within communities (Puska and others 1998).

Many countries are undertaking efforts to educate their populations about healthy lifestyles. In the Islamic Republic of Iran, the Isfahan Healthy Heart Program, a WHO collaborating center for research and training for CVD control, prevention, and rehabilitation for cardiac patients, has developed a comprehensive, integrated community intervention that involves schools, worksites, health care facilities, food services, urban planners, and the media. Physical activity is promoted by creating safe routes for walking and bicycle riding and by organizing recreational walking that involves entire families (<http://ihhp.mui.ac.ir>).

South Africa’s Community Health Intervention Programme, a partnership between an insurance company and an academic institution, has created programs targeted to specific age groups, including children and older adults. The program’s twice-weekly classes have reduced blood pressure and increased strength and balance (Lambert, Bohlmann, and Kolbe-Alexander 2001) (box 44.9).

Singapore’s Fit and Trim Program uses a multidisciplinary approach to increase physical activity and healthy diets among schoolchildren. Between 1992 and 2000, the rate of obesity declined by 13.1 to 16.6 percent for children age 11 to 12 and 15 to 16 (Toh, Cutter, and Chew 2002) (box 44.10 outlines the national program for adults).

Economic Policies

Economic policies can have important effects on behavior and choices, and these policies have been particularly useful in

Box 44.9

A Comprehensive Intervention Approach in South Africa

The Coronary Risk Factor Study in South Africa (Rossouw and others 1993) tested community interventions at different levels of intensity in two communities with a third control community. The target population was Caucasian South Africans. Interventions included direct media campaigns, public health messages delivered in a variety of ways, and home mailings. Also included were community activities, such as fun walks, public meetings, involvement of community-based organizations, free screening for blood pressure, small-group personal interventions, and encouragement of food substitution in stores and restaurants. The

results showed an improvement in the community risk factor profile for CAD in the intervention communities, especially in relation to blood pressure, smoking, and overall risk. The results indicate no additional benefit of the personal intervention for high-risk individuals beyond that already offered by the mass media program. Estimated per capita costs of the heavy intervention program were roughly four times as much as for the mild intervention program (US\$22 per capita compared with US\$5 per capita), and the low-intervention community received almost the same level of benefits as the high-intervention community.

Box 44.10

The Singapore National Healthy Lifestyle Program

Because CVD and cancer had become the major causes of death in Singapore, the government adopted the National Healthy Lifestyle Program in 1992 (Cutter, Tan, and Chew 2001). This coordinated, multisectoral approach involved government ministries, health professionals, employers, unions, and community organizations. The program aimed at improving the social and physical environment so as to promote healthy living. Healthy diets, regular physical exercise, and nonsmoking were emphasized. The program used the mass media; legislative measures to discourage smoking; and widespread school, workplace, and community health promotion packages.

In a follow-up survey after six years, cigarette smoking had decreased from 34 to 27 percent among men, the proportion of adults who exercised regularly had increased from 14 to 17 percent, and the prevalence of obesity was stable. However, hypertension and high LDL cholesterol levels had increased modestly. From 1991 to 1999, the age-standardized incidence of myocardial infarction declined from 98.2 to 83.0 per 100,000 residents (Mak and others 2003) and age-standardized mortality from CAD decreased from 60.8 to 47.2 per 100,000 residents.

reducing the prevalence of smoking (see chapter 46). Policies that could influence diet and physical activity deserve careful consideration because they are rarely neutral and often support unhealthy behaviors. Consider the following examples:

- Subsidies can favor the consumption of less healthy foods, such as sugar, refined grains, beef, and high-fat dairy products as opposed to fruits, vegetables, whole grains, nuts, legumes, and fish. Poland provides a striking example of how changes in subsidies can affect health (box 44.11). Governments often subsidize foods indirectly by sheltering them from sales taxes in the recognition that they are essential; however, this logic should not extend to foods with adverse health effects, such as sugar-sweetened beverages

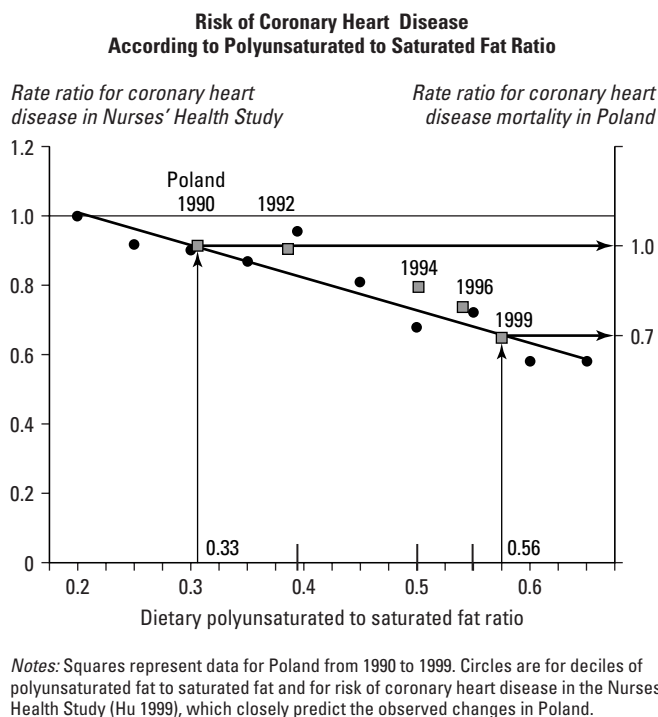
and those high in trans fats. Legislation can make this distinction, providing a modest economic incentive for healthier choices and at the same time conveying important nutritional messages (see chapter 11).

- Use of individual automobiles is often subsidized by building and maintaining highways, providing inexpensive parking, and imposing low taxes on petroleum products that do not fully reflect their societal and environmental costs. Increasing taxes on petroleum products and subsidizing public transportation could have an important effect on choice of transportation modality, which as noted earlier, has major effects on health.
- Walking, riding bicycles, and using public transportation can be promoted by economic policies that, in addition

Box 44.11

Poland: A Dramatic Decline in Heart Disease

After Poland's transition to a democratic government in the early 1990s, the government removed large subsidies for butter and lard, and consumption of nonhydrogenated vegetable fat increased rapidly (Zatonski, McMichael, and Powles 1998). The ratio of dietary polyunsaturated to saturated fat increased from 0.33 in 1990 to 0.56 in 1999, and during this period mortality rates from CAD dropped by 28 percent (data provided by W. Zatonski). Changes in smoking and in the consumption of fruits and vegetables probably played a minor role in this decrease (see figure).



to providing better infrastructure, include discounts on transportation fares, provide secure bicycle parking, and reduce health insurance premiums.

COST-EFFECTIVENESS OF INTERVENTIONS

Only a few studies have described interventions for lifestyle diseases in developing countries.

Modeling Likely Interventions

Primary targets for reducing lifestyle diseases include changing the fat composition of the diet, limiting sodium intake, and engaging in regular physical activity.

Using available data, we calculated a range of estimates under given assumptions for the cost-effectiveness of replacing dietary saturated fat with monounsaturated fat, replacing trans fat with polyunsaturated fat, and reducing salt intake. An increase in moderate physical activity by three to five hours per week is considered likely to lower the risk of many diseases, but data to model the cost-effectiveness of this intervention are not currently available. For further details of methods and assumptions underlying the analyses presented here, see the Web site version of this book.

Reducing Saturated Fat Content. In the base case, assuming a 3 percent drop in cholesterol and a US\$6 per person cost of the intervention, averting one disability-adjusted life year (DALY) would cost as little as US\$1,865 in South Asia and as much as US\$4,012 in the Middle East and North Africa. The intervention's effectiveness could be increased by replacing part of the saturated fat with polyunsaturated fat, which has additional beneficial effects mediated by mechanisms other than LDL cholesterol (see tables 44.2 and 44.3).

Replacing Dietary Trans Fat from Partial Hydrogenation with Polyunsaturated Fat. We could not use the model for saturated fat to estimate the effects of replacing trans fat with polyunsaturated fat because only a small part of the benefit is attributable to reducing LDL cholesterol (F. B. Hu and Willett 2002). Trans fats also adversely affect high-density lipoprotein (HDL) cholesterol, triglycerides, endothelial function, and inflammatory markers. In addition, increases in polyunsaturated fat (assuming a mix of N-6 and omega-3 fatty acids) will reduce LDL cholesterol, insulin resistance, and probably fatal cardiac arrhythmias.

In calculations that are based only on the adverse effects on LDL and HDL, replacing 2 percent of the energy from trans fat

Table 44.2 Incremental Cost-Effectiveness Ratios, Selected Interventions, by Region
(US\$/DALY averted)

Region	Media campaign to reduce saturated fat content	Substituting 2 percent of energy from trans fat with polyunsaturated fat				Reducing salt content by means of legislation plus public education
		7 percent CAD reduction		40 percent CAD reduction		
		Intervention cost of US\$0.50/adult ^a	Intervention cost of US\$6.00/adult	Intervention cost of US\$0.50/adult ^a	Intervention cost of US\$6.00/adult	
East Asia and the Pacific	2,769	73	1,583	Cost saving	227	2,056
Europe and Central Asia	2,929	65	1,670	Cost saving	228	2,170
Latin America and the Caribbean	3,297	40	1,865	Cost saving	225	2,476
Middle East and North Africa	4,012	25	2,259	Cost saving	252	3,056
South Asia	1,865	38	1,014	Cost saving	138	1,325
Sub-Saharan Africa	2,356	53	1,344	Cost saving	184	1,766

Source: Authors' calculations.

a. Based on the U.S. Food and Drug Administration's analysis of the costs of the intervention in the United States.

Table 44.3 Two-Way Sensitivity Analysis of the Costs of the Intervention to Reduce Saturated Fat Content and of the Relative Risk Reduction in CAD Events, South Asia (US\$/DALY averted)

Relative risk reduction in CAD events (percent)	Cost per individual		
	US\$0.25	US\$3.00	US\$6.00 ^a
10	Cost saving	318	680
5	Cost saving	680	1,403
4 ^b	Cost saving	911	1,865
1	258	3,572	7,188

Source: Authors' calculations.

a. Threshold analysis reveals that at the base assumption of US\$6 for the intervention, no level in the range of assumed CAD reduction is cost saving.

b. Threshold analysis reveals that at a cost below US\$0.36 per individual and a 4 percent reduction in CAD (base assumption), the intervention is cost saving.

with polyunsaturated fat was estimated to reduce CAD by 7 to 8 percent (Grundy 1992; Willett and Ascherio 1994). Epidemiological studies, which include the contributions of the additional causal pathways, suggest a much greater reduction, from about 25 to 40 percent (F. B. Hu and others 1997; Oomen and others 2001). Another likely benefit is a reduction in the incidence of type 2 diabetes: estimates indicate that the same 2 percent reduction would reduce incidence by 40 percent (Salmeron and others 2001).

Because voluntary action by industry (as has nearly been achieved in the Netherlands) or by regulation (as occurred in Denmark) can eliminate partially hydrogenated fat from the diet, this initiative does not require consumer education, and the costs can be extremely low. In an analysis required before implementing food labeling, the U.S. Food and Drug Administration (2003) estimated that trans fat labeling would be highly cost-effective. Even though the effect of labeling itself

was estimated to have only a modest effect on consumer behavior, as noted earlier, it is having a major effect on manufacturers' behavior.

The potential for reducing CVD rates by replacing trans fats with polyunsaturated fats will depend on the diets of specific populations. Whereas the intake of trans fat is low in China, it is likely to be high in parts of India, Pakistan, and other Asian countries because of the extraordinarily high content in commonly used cooking fats.

Table 44.2 presents the results of a cost-effectiveness analysis assuming the two different estimates for CAD reduction: 7 percent and 40 percent. We used costs of US\$0.50 per adult per year, which was the maximal cost in the U.S. Food and Drug Administration analysis, and of US\$6.00 per adult per year using traditional health education approaches. The lower estimate—or one even lower—is possible because trans fat can be eliminated at the source rather than depending entirely on changes in individual behavior. With the lower cost, the smaller effect estimate leads to a cost-effectiveness ratio of between US\$25 and US\$73 per DALY averted, depending on the region, and with the higher-effect estimate, the intervention can be cost saving.

Reducing the Salt Content of Manufactured Foods through Legislation and an Accompanying Education Campaign.

Table 44.2 shows the base-case cost-effectiveness of a legislated reduction in salt content. The intervention appears to be relatively cost-effective, with a cost per DALY averted of US\$1,325 in South Asia to US\$3,056 in the Middle East and North Africa. Those regional variations are attributable to differing risk profiles across regions as well as to price differentials for the costs of treating disease sequelae.

The actual blood pressure reduction from lower salt consumption could vary from the base-case assumption, as could the costs of the education campaign. Table 44.4 shows the

Table 44.4 Two-Way Sensitivity Analysis of the Costs of the Intervention to Reduce Salt Content and Its Effectiveness, South Asia (US\$/DALY averted)

Blood pressure reduction (millimeters of mercury)	Cost per individual		
	US\$1a	US\$3	US\$6
4	9	308	608
3	49	448	847
2 ^b	129	727	1,326
1	368	1,565	2,761

Source: Authors' calculations.

a. Threshold analysis reveals that at a cost of US\$1 per individual, a blood pressure reduction would have to be greater than 5 millimeters of mercury for the intervention to be cost saving. At the base-case assumption of a cost of US\$6 for the intervention, there is no cost saving threshold level of reduction.

b. Threshold analysis reveals that at a cost of less than US\$0.47 per individual the intervention is cost-saving.

results of lower costs of the education campaign and higher or lower effects of the intervention on blood pressure. These results may argue for initial efforts to focus on reductions in the use of salt during the manufacturing process with no public education campaign. The cost-effectiveness of such a change is high and could be augmented with a public education campaign only if needed to support the legislated change. At lower implementation costs, the intervention is highly cost-effective, even with half the assumed effect on blood pressure.

Adopting Physical Activity Interventions. Even though health experts believe that physical activity interventions are effective in reducing the risk of lifestyle diseases, no studies of their cost-effectiveness are available from developing countries. If people walk voluntarily (the model assumes no opportunity cost), a net economic benefit would accrue to all segments of the U.S. population. If we project the economic benefits to the entire U.S. population and assume 25 percent compliance by the sedentary population, the voluntary program would generate US\$6.8 billion in savings (in 2001 U.S. dollars).

Aggregate Costs of Obesity and Unhealthy Lifestyles

A series of U.S. studies appears to confirm that the avoidable costs of chronic diseases are substantial, although many developing countries have not yet experienced the full demands on their health sectors resulting from these conditions. Colditz (1999) estimates that obesity is responsible for 7 percent of all U.S. direct health care costs and that inactivity is responsible for an additional 2.4 percent of all health care costs. Indirect costs associated with obesity and inactivity account for another 5 percent of health care costs. Pronk and others (1999) assess the difference in health care costs between adult patients with

and without risk factors for noncommunicable diseases (physical activity, BMI, and smoking status) and find that a healthier lifestyle of physical activity three times per week, a moderate BMI, and nonsmoking status reduce health care costs by 49 percent compared with an unhealthy lifestyle.

Cost-Effectiveness of Community-Based Interventions

Populationwide and community-based interventions appear to be cost-effective if they reach large populations, address high-mortality and high-morbidity diseases, and are multipronged and integrated efforts. The full costs of achieving changes in behavior and policy are often complex and difficult to estimate. Interventions may yield additional spinoff benefits. For instance, decisions to reduce children's television viewing could easily improve school outcomes as well as reduce childhood obesity. Similarly, increasing walking and bicycle riding for transportation could reduce air pollution.

RESEARCH AND DEVELOPMENT PRIORITIES

A number of research and development priorities have been identified:

- Conduct randomized trials of the use of folic acid and alpha-linoleic acid to prevent CAD in developing countries. These interventions cost little, and the potential benefits are large and rapid.
- Develop prospective cohort studies of dietary and lifestyle factors in developing and transition countries to refine the understanding of risk factors in those contexts. To date, almost all such studies have taken place in Europe and North America.
- Develop surveillance systems for chronic diseases and for major risk factors, such as obesity, in developing countries.
- Develop additional multifaceted, community-based demonstration programs in developing countries to document the feasibility of lifestyle changes and to learn more about effective strategies.
- Conduct detailed cost-effectiveness analyses of various prevention strategies to modify dietary and lifestyle factors.

RECOMMENDED PRIORITY INTERVENTIONS

An overall objective is to develop comprehensive national and local plans that take advantage of every opportunity to encourage and promote healthy eating and active living. These plans would involve health care providers; worksites; schools; media; urban planners; all levels of food production, processing, and preparation; and governments. The goal is cultural change in the direction of healthy living. An important element in

cultural change is national leadership by individuals and by professional organizations. Specific interventions will depend on local physical and cultural conditions and should be based on careful analysis of existing dietary and activity patterns and their determinants; however, the following interventions can be considered (specific interventions for control of smoking are discussed elsewhere):

- Physical activity:
 - Develop transportation policies and a physical environment to promote walking and riding bicycles. This intervention includes constructing sidewalks and protected bicycle paths and lanes that are attractive, safe, well-lighted, and functional with regard to destinations.
 - Adopt policies that promote livable, walker-friendly communities that include parks and are centered around access to public transportation.
 - Encourage the use of public transportation and discourage overdependence on private automobiles.
 - Promote the use of stairs. Building codes can require the inclusion of accessible and attractive stairways.
- Healthy diets:
 - Develop comprehensive school programs that integrate nutrition into core curricula and healthy nutrition into school food services. Regional or national standards to promote healthy eating should be developed for school food services. Programs should also aim at limiting television watching, in part by promoting attractive alternatives.
 - Work with the agriculture sector and food industries to replace unhealthy fats with healthy fats, including adequate amounts of omega-3 fatty acids. This goal can be achieved through a combination of education, regulation, and incentives. Specific actions will depend on local sources of fat and on regional production and distribution. For example, in areas where palm oil is dominant, research could focus on developing strains that are lower in saturated fat and higher in unsaturated fat through selective breeding or genetic alteration. Labeling requirements or regulation can be used to discourage or eliminate the use of partially hydrogenated vegetable oils and to promote the use of nonhydrogenated unsaturated oils instead.
 - Require clear labeling of energy content for all packaged foods, including fast food.
 - Use tax policies to encourage the consumption of healthier foods. For example, high-sugar sodas could be fully taxed and not subsidized in the same way as healthier foods.
 - Emphasize the production and consumption of healthy food products in agriculture support and extension programs.
- Implement folic acid fortification if folic acid intake is low.
- Ensure that health providers regularly weigh both children and adult patients, track their weights over time, and provide counseling regarding diet and activity if they are already overweight or if unhealthy weight gain is occurring during adulthood. Those activities should be integrated with programs that address undernutrition. Health care providers should be encouraged to set a good example by not smoking, by exercising regularly, and by eating healthy diets.
- Promote healthy foods at worksite food services. Worksites can also promote physical activity by providing financial incentives for using public transportation or riding bicycles (and by not subsidizing automobiles by providing free parking). Providing areas for exercise during work breaks and showers may be useful.
- Set standards that restrict the promotion of foods high in sugar, refined starch, and saturated and trans fats to children on television and elsewhere.
- Set national standards for the amount of sodium in processed foods.
- National campaigns:
 - Invest in developing locally appropriate health messages related to diet, physical activity, and weight control. This effort is best done in cooperation with government agencies, nongovernmental organizations, and professional organizations so that consistent messages can be used on television and radio; at health care settings, schools, and worksites; and elsewhere. This effort should use the best social-marketing techniques available, with messages continuously evaluated for effectiveness.
 - Develop a sustainable surveillance system that monitors weight and height, physical activity, and key dietary variables.

Implementation of the recommended policies to promote health and well-being is often not straightforward because of opposition by powerful and well-funded political and economic forces, such as those involved in the tobacco, automobile, food, and oil industries (Nestle 2002). The solutions will depend on a country's specific political landscape. However, experiences in many countries indicate that alliances of public interest groups, professional organizations, and motivated individuals can overcome such powerful interests. Strategies should start with sound science and can use a mix of mass media, lobbying efforts, and lawsuits. Also, the food industry is far from monolithic, and elements can often be identified whose interests coincide with health promotion, which can create valuable partnerships. As an example, the willingness of some margarine manufacturers to invest in developing products free of trans fatty acids greatly helped the effort to reduce these fats, because these producers

then became proponents for labeling the trans fat content of foods. Protection of children can be a powerful lever because of almost universal concern about their welfare and the recognition that they cannot be responsible for the long-term consequences of their diet and lifestyle choices.

CONCLUSIONS

Many of the ongoing diet and lifestyle interventions in low- and middle-income countries are relatively recent, and few have documented reductions in the rates of major chronic diseases. However, the successes of Finland, Singapore, and many other high-income countries in reducing rates of CAD, stroke, and smoking-related cancers strongly suggest that similar benefits will emerge in the developing countries.

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